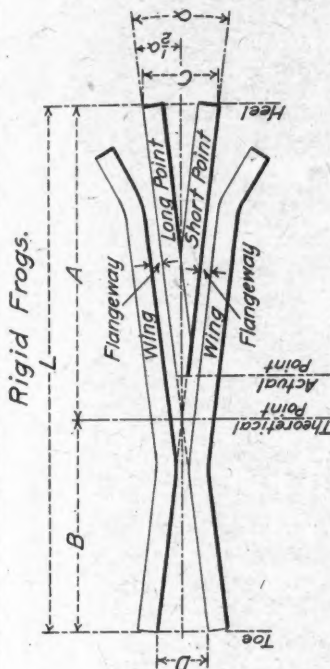


# FROGS, SWITCHES AND CROSS-OVERS-I



## Formulas for Rigid Frogs

$$N = \text{no. of frog}, \quad N = \frac{L}{C + D}, \quad \tan \frac{1}{2} \alpha = \frac{1}{2N}$$

$$L = \text{length over all}, \quad C = 2A \times \tan \frac{1}{2} \alpha = \frac{A}{N}$$

$$C = \text{heel spread}, \quad D = \text{toe spread}, \quad \alpha = \text{angle of frog.} \quad D = 2B \times \tan \frac{1}{2} \alpha = \frac{B}{N}$$

There are three types of rigid frogs.

1. Bolted: Filling in flangeway and held together by bolts.
2. Clamped: Filling in flangeway and held together by clamps.
3. Riveted: Rail bases riveted to a base plate.

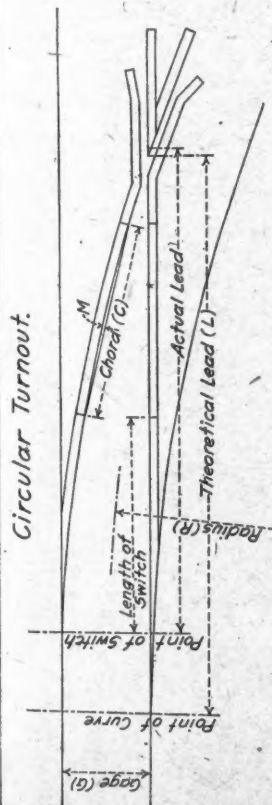
Table of Frog Numbers and Angles.

Num-ber	Angle	Num-ber	Angle	Num-ber	Angle	Num-ber	Angle	Num-ber	Angle	Num-ber	Angle	Num-ber	Angle	Num-ber	Angle
1 1/2	36°52'	3	18°55'	5	11°25'	8	7°09'	12	4°46'	18	3°11'				
1 3/4	31°53'	3 1/4	17°30'	5 1/2	10°23'	8 1/2	6°44'	13	4°24'	19	3°01'				
2	28°04'	3 1/2	16°16'	6	9°32'	9	6°22'	14	4°05'	20	2°52'				
2 1/4	25°03'	3 3/4	15°11'	6 1/2	8°48'	9 1/2	6°02'	15	3°49'						
2 1/2	22°37'	4	14°15'	7	8°10'	10	5°43'	16	3°35'						
2 3/4	20°37'	4 1/2	12°41'	7 1/2	7°38'	11	5°12'	17	3°22'						

Contributed by Frank W. Holcomb

No. 131, Data Sheet, MACHINERY, June, 1910

# FROGS, SWITCHES AND CROSS-OVERS-II



$$G = \text{gauge (inside width between rail-heads)}, \quad L = 2G \times N = (R + \frac{1}{2}G) \sin \alpha$$

$$R = \text{radius of curve}, \quad R = 2G \times N^2 \times \frac{50}{\sin^2 \frac{1}{2} \delta} = \frac{L^2}{2G}$$

$$L = \text{theoretical lead of switch}, \quad \cos \alpha = \frac{R - \frac{1}{2}G}{R + \frac{1}{2}G}; \quad \tan \frac{1}{2} \alpha = \frac{G}{L}$$

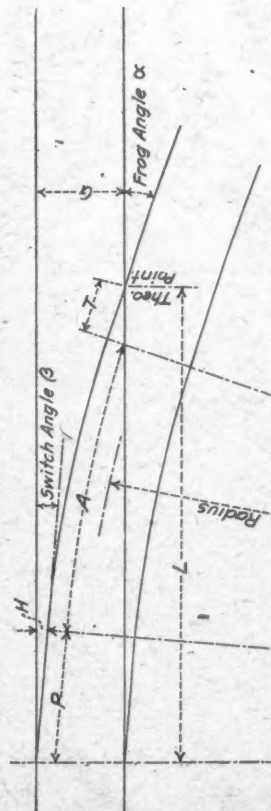
$$C = \text{chord (see illustration above)}, \quad R = \frac{1}{2} \left( \frac{L^2}{C^2} + M \right)$$

$$M = \text{middle ordinate (see illustration)}, \quad \sin \frac{1}{2} \delta = \frac{50}{R}$$

$$N = \text{number of frog (see Sheet I)}, \quad \alpha = \text{frog angle (see Sheet I)}, \quad R = \frac{G}{\text{vers } \alpha} - \frac{1}{2}G$$

$$\delta = \text{degree of curve.}$$

## Turnout Using Straight Frog and Switch.



$$H = \text{heel spread of switch}, \quad P = \text{length of switch,}$$

$$T = \text{distance from theoretical point to toe of frog,} \quad \beta = \text{switch angle.}$$

$$R + \frac{1}{2}G = \frac{G - H}{\cos \beta} - \cos \alpha$$

$$L = (R + \frac{1}{2}G) (\sin \alpha - \sin \beta) + (T \times \cos \alpha) + P$$

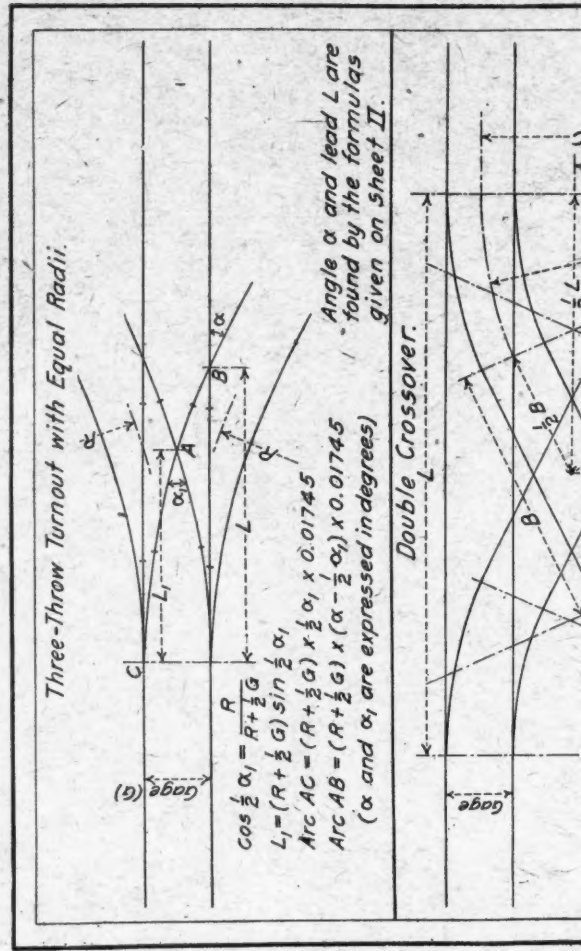
$$\text{Length of arc. } A = (\alpha - \beta) (R + \frac{1}{2}G) \times 0.01745$$

( $\alpha$  and  $\beta$  are expressed in degrees)

Contributed by Frank W. Holcomb

No. 131 Data Sheet, MACHINERY, June, 1910

FROGS, SWITCHES AND CROSS-OVERS-III



Contributed by Frank W. Holcomb

FROGS, SWITCHES AND CROSS-OVERS-IV

Radius, Feet	Gage 2'6"		Gage 3'0"		Gage 3'4"		Gage 3'6"	
	Angle	Theo. Lead	Angle	Theo. Lead	Angle	Theo. Lead	Angle	Theo. Lead
10	38°57'	7'1"	42°21'	7'9"	44°25'	8'2"	45°24'	8'4"
12	35°46'	7'9"	38°57'	8'6"	40°53'	8'11"	41°48'	9'2"
14	33°16'	8'4"	36°15'	9'2"	38°05'	9'8"	38°57'	9'11"
16	31°14'	8'11"	34°03'	9'10"	35°58'	10'4"	36°36'	10'7"
18	29°32'	9'6"	32°12'	10'5"	33°51'	10'11"	34°38'	11'3"
20	28°04'	10'0"	30°38'	10'11"	32°12'	11'7"	32°57'	11'10"
25	25°13'	11'2"	27°32'	12'3"	29°00'	12'11"	29°38'	13'3"
30	23°04'	12'3"	25°13'	13'5"	26°32'	14'2"	27°09'	14'6"
35	21°24'	13'3"	23°24'	14'6"	24°37'	15'3"	25°13'	15'8"
40	20°03'	14'2"	21°55'	15'6"	23°04'	16'4"	23°38'	16'9"
50	17°58'	15'10"	19°39'	17'4"	20°42'	18'3"	21°12'	18'8"
60	16°26'	17'4"	17°58'	19'0"	18°56'	20'0"	19°23'	20'6"
70	15°13'	18'8"	16°39'	20'6"	17°33'	21'7"	17°58'	22'2"
80	14°15'	20'0"	15°36'	21'11"	16°26'	23'1"	16°50'	23'8"

Contributed by Frank W. Holcomb



Radius, Feet	Gage 3'8"			Gage 4'8 1/2"			Gage 4'8 1/2"		
	Theo. Angle	Radius, Feet	Theo. Lead	Theo. Angle	Radius, Feet	Theo. Lead	Number	Theo. Angle	Theo. Radius
50	17°58'	15'10"	19°39'	17°4'	17°58'	19°0"	20'42"	18°3"	21'12"
60	16°26'	17'4"	17°58'	19°0"	18°56'	20°0"	18°56'	20°0"	19°23'
70	15°13'	18'8"	16°39'	20°6"	17°33'	21°7"	17°33'	21°7"	17°58'
80	14°15'	20'0"	15°36'	21°11"	16°26'	23°1"	16°26'	23°1"	16°50'
90	13°27'	21'3"	14°42'	23°3"	15°30'	24°6"	15°30'	24°6"	15°53'
100	12°46'	22'4"	13°58'	24°6"	14°43'	25°10"	14°43'	25°10"	15°04'
10	46°21'	8'7"	31°18'	16°10"	4	14°15'	37°8'	150.6	38°46'
12	42°42'	9'5"	40	27°16'	19°5"	4 1/2	12°41'	42°4'	190.6
14	39°47'	10'2"	50	24°29'	21°8"	5	11°25'	47°1'	235.4
16	37°24'	10'10"	60	22°24'	23°9"	5 1/2	10°23'	51°9'	284.8
18	35°24'	11'6"	70	20°47'	25°8"	6	9°32'	56°6'	338.9
20	33°41'	12'1"	80	19°28'	27°5"	6 1/2	8°48'	61°2'	397.8
25	30°18'	13'6"	90	18°22'	29°1"	7	8°10'	65°11'	461.3
30	27°46'	14'10"	100	17°27'	30°8"	7 1/2	7°38'	70°7'	529.6
35	25°47'	16'0"	110	16°39'	32°2"	8	7°09'	75°4'	602.6
40	24°10'	17'1"	120	15°57'	33°7"	8 1/2	6°44'	80°0'	680.3
50	21°41'	19'2"	130	15°20'	35°0"	9	6°22'	84°9'	762.6
60	19°50'	21'0"	140	14°39'	36°4"	9 1/2	6°02'	89°5'	849.7
70	18°23'	22'8"	150	14°17'	37°7"	10	5°43'	94°2'	941.6
80	17°13'	24°3"	160	13°50'	38°10"	11	5°12'	103°7'	1139.3
90	16°15'	25°8"	170	13°25'	40°0"	12	4°46'	113°0'	1355.9
100	15°26'	27°1"	180	13°03'	41°2"				

